

12/15/98  
JC498 U.S. PTO

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A

JC540 U.S. PTO  
09/21/27  
12/15/98

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Admitted in California,  
Utah, and Wisconsin

Registered Patent Attorney

December 15, 1998

Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Re: Patent Application for  
Electric Motor with Rotor Being a Drive Wheel  
Our File No. PBRANAEM

Dear Commissioner:

I have enclosed for appropriate attention the above-referenced Patent Application as well as the applicable filing fee of \$614.00.

Thank you for handling this matter.

Very truly yours,

*Thompson E. Fehr*  
Thompson E. Fehr  
Reg. No. 31353

TEF/msg

Enclosure

Express Mail Label No. EE235313804US

**PATENT**

In re application of: Adam K. Brandle and John R. Irwin  
Serial No.:  
Filed:  
For: Electric Motor with Rotor Being a Drive Wheel  
Group Art Unit:  
Examiner:  
Attorney Docket No.: PBRANAEM

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27(b))--INDEPENDENT INVENTOR**

As a below-named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled Electric Motor with Rotor Being a Drive Wheel described in the specification filed herewith.

I have not assigned, granted, conveyed, or licensed and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

Daylynn Brandle  
1585 West 400 North  
Ogden, Utah 84404

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are

**VERIFIED STATEMENT (DECLARATION)  
CLAIMING SMALL ENTITY STATUS (37 CFR  
1.9(f) AND 1.27(b))--INDEPENDENT INVENTOR**

punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Adam K. Brandley  
Inventor



Signature of Inventor

Date: Dec. 15<sup>th</sup>, 1998

U.S. PATENT AND TRADEMARK OFFICE  
DEPT. OF COMMERCE  
1100 L ST., NW  
WASH. D.C. 20591  
(202) 707-3000

**PATENT**

In re application of: Adam K. Brandley and John R. Irwin  
Serial No.:  
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I have not assigned, granted, conveyed, or licensed and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

Daylynn Brandley  
1585 West 400 North  
Ogden, Utah 84404

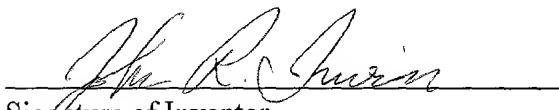
I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are

**VERIFIED STATEMENT (DECLARATION)  
CLAIMING SMALL ENTITY STATUS (37 CFR  
1.9(f) AND 1.27(b))--INDEPENDENT INVENTOR**

punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

John R. Irwin  
Inventor

  
\_\_\_\_\_  
Signature of Inventor

Date: December 13, 1998

INVENTOR'S SIGNATURE

VERIFIED STATEMENT (DECLARATION)  
CLAIMING SMALL ENTITY STATUS (37 CFR  
1.9(f) AND 1.27(b))--INDEPENDENT INVENTOR

Page 2 of 2

Express Mail Label No. EE235313804US

**PATENT**

In re application of: Adam K. Brandley and John R. Irwin  
Serial No.:  
Filed:  
For: Electric Motor with Rotor Being a Drive Wheel  
Group Art Unit:  
Examiner:  
Attorney Docket No.: PBRANAEM

**VERIFIED STATEMENT (DECLARATION) BY A NON-INVENTOR  
SUPPORTING A CLAIM BY ANOTHER FOR SMALL ENTITY STATUS**

I hereby declare that I am making this verified statement to support a claim by Adam K. Brandley and John R. Irwin for small entity status for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, with regard to the invention entitled Electric Motor with Rotor Being a Drive Wheel by inventors Adam K. Brandley and John R. Irwin described in the specification filed herewith.

I hereby declare that I would qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying fees under Section 41(a) and (b) of title 35, United States Code, if I had made the above identified invention.

I have not assigned, granted, conveyed, or licensed and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

Pioneering Research and Development, L.L.C.  
1585 West 400 North  
Ogden, Utah 84404

INDIVIDUAL  SMALL BUSINESS CONCERN  
 NONPROFIT ORGANIZATION

**VERIFIED STATEMENT (DECLARATION) BY A  
NON-INVENTOR SUPPORTING A CLAIM BY  
ANOTHER FOR SMALL ENTITY STATUS**

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Daylynn Brandley

ADDRESS OF PERSON SIGNING: 1585 West 400 North  
Ogden, Utah 84404

SIGNATURE



Date

12-15-98

Express Mail Label No. EE235313804US

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of: Adam K. Brandley and John R. Irwin

Serial No.:

Filed:

For: Electric Motor with Rotor Being a Drive Wheel

Group Art Unit:

Examiner:

Attorney Docket No.: PBRANAEM

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27(c))--SMALL BUSINESS CONCERN**

I hereby declare that I am an official of the small business concern empowered to act on behalf of the concern identified below:

Pioneering Research and Development, L.L.C.  
1585 West 400 North  
Ogden, Utah 84404

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.1301-1305, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to, and remain with, the small business concern identified above with regard to the invention entitled Electric Motor with Rotor Being a Drive Wheel by inventors Adam K. Brandley and John R. Irwin described the specification filed herewith.

**VERIFIED STATEMENT (DECLARATION)  
CLAIMING SMALL ENTITY STATUS (37 CFR  
1.9(f) AND 1.27(c))--SMALL BUSINESS CONCERN**

If the rights held by the above-identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention is listed below; and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

INDIVIDUAL       SMALL BUSINESS CONCERN

NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Adam K. Brandley

TITLE OF PERSON OTHER THAN OWNER: Manager

ADDRESS OF PERSON SIGNING: 1585 West 400 North  
Ogden, Utah 84404

SIGNATURE Adam K. Brandley

Date: December 15<sup>th</sup>, 1998

VERIFIED STATEMENT (DECLARATION)  
CLAIMING SMALL ENTITY STATUS (37 CFR  
1.9(f) AND 1.27(c))--SMALL BUSINESS CONCERN

1 December 15, 1998  
2 Express Mail Label No.: EE235313804US PATENT

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11 UNITED STATES PATENT APPLICATION

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of

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14 INVENTOR: ADAM K. BRANDLEY

15

A Citizen of the United States

16

1585 West 400 North

17

OGDEN, UTAH 84404

18

and

19

INVENTOR: JOHN R. IRWIN

20

A Citizen of the United States

21

1105 West 5575 South

22

RIVERDALE, UTAH 84405

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24

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for

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ELECTRIC MOTOR WITH ROTOR BEING A DRIVE WHEEL

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1                   BACKGROUND OF THE INVENTION  
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3                   FIELD OF THE INVENTION

4                 This invention relates to electric motors, specifically to an electric motor where the rotor  
5                 of the motor also functions as a drive wheel.

6                   DESCRIPTION OF THE RELATED ART  
7

8                 At least three United States patents apply to electric motors where a portion of the electric  
9                 motor serves as a drive wheel, rather than providing power to a shaft which transfers such power  
10                to another component. These are United States Patent No. 3,548,965 of John J. Pierro; United  
11                States Patent No. 5,164,623 of Vasily V. Shkondin; and United States Patent No. 5,721,473 of  
12                LeRoy M. DeVries.

13                Patent No. 3,548,965 involves a rather complicated rotor primarily composed of two  
14                adjacent ferromagnetic circles, each having projections which extend toward the other circle and  
15                which projections from one circle are interdigitated with the projections from another circle. The  
16                rotor, itself, contains no magnet--either permanent or electromagnetic. A field excitation coil  
17                projects a magnetic field into both circles of the rotor. (It is stated that in some cases the field  
18                excitation coil may be replaced with one or more permanent magnets.) The magnetic field  
19                created by the field excitation coil interacts with a magnetic field created by stator conductor  
20                windings. To produce rotation of the rotor, the electric current through the stator conductor  
21                windings is supplied at a frequency which is calculated from a formula which includes the  
22                tangential velocity of the rotor. Such tangential velocity is determined by a commutator which is  
23                “preferably of electromagnetic type. . . .”

24                The motor of Patent No. 5,164,623 utilizes a mechanic commutator, which--being a  
25                mechanical device in which different physical parts make moving contact with one another--is  
26                subject to wear as well as physical breakage and, therefore, to malfunction. Additionally, from  
27                the drawings it appears that the electromagnets of the rotor are located radially outward from the  
28                (preferably permanent) magnets of the stator. The disclosure and claims merely state that the

1       “magnetic members” of the stator are mounted on the circumference of the stator and face the  
2       electromagnets of the rotor.

3           And the rotor associated with the motor of Patent No. 5,721,473 includes both permanent  
4       magnets and electromagnets. It is suggested on lines 62 through 64 in column 5 of Patent No.  
5       5,721,473 that the electromagnets of the rotor are necessary in order to achieve adequate  
6       acceleration: “When the electromagnets **16** are magnetized and incited by the wire coil stator **17**,  
7       a wheel accelerates very fast.” And, although the disclosure does not clearly specify the  
8       orientation of the magnets on the rotor with respect to the “wire coil stator,” the drawings and the  
9       claim indicate that the magnets of the rotor are located radially outward from the “wire coil  
10      stator.” In pertinent part, the claim states: “a tire and rim rotor which includes a plurality of  
11      oppositely placed interchangeable permanent and electro magnets that rotate said tire and rim  
12      rotor by means of an electric field excited by an interchangeable wire coil stator secured onto a  
13      stationary axle . . . .”

14           In its description of the prior art, Patent No. 5,164,623 discusses several patents issued by  
15      the former Soviet Union but states that the “independent-drive wheel[s]” of such patents have  
16      “poor controllability because of the absence of a link between dynamics of rotation and control  
17      signals.”

## **SUMMARY OF THE INVENTION**

2 The present Electric Motor with Rotor Being a Drive Wheel minimizes the possibility of  
3 failure by not utilizing mechanical commutators. Moreover, the current invention does not  
4 require the use of a formula to compute a frequency for the time when the electromagnets should  
5 be energized.

In the present invention, permanent magnets are placed upon one or both of the lateral sides of the drive wheel, forming the rotor. Electromagnets are attached to the structure that supports the axle for the drive wheel, creating the stator. Such electromagnets are arranged generally in a plane that is substantially parallel to the plane or planes containing the permanent magnets and are sufficiently close to the permanent magnets that the magnetic fields of the electromagnets and the permanent magnets will interact with one another. If permanent magnets are placed upon both of the lateral sides of the drive wheel, electromagnets may be placed upon both sides of the structure that supports the axle for the drive wheel.

14 \* A sensor mounted on the structure that supports the axle for the drive wheel simply  
15 determines when a pole of a permanent magnet approaches or is near such sensor. The sensor is  
16 so located (1) that when such pole approaches or is near the sensor, magnetic attraction or  
17 repulsion between the permanent magnet and an electromagnet will produce a force in the  
18 direction that it is desired to rotate the drive wheel and (2) that when the opposite pole of the  
19 electromagnet approaches or is near the sensor, magnetic attraction or repulsion between the  
20 permanent magnet and an electromagnet would not produce a force in the direction that it is  
21 desired to rotate the drive wheel.

22 Three methods are employed for utilizing the information from the sensor both (1) to  
23 assure that the electromagnets will be energized only when such energization will produce a  
24 force in the desired direction and (2) to control the speed of the drive wheel.

25 The control of speed depends upon the fact that the speed of the drive wheel is  
26 proportional to the average power (and, therefore, the average voltage) supplied to the  
27 electromagnets. Consequently, the speed of the drive wheel is determined by regulating the  
28 average voltage that is supplied to the electromagnets.

1        All three methods control such average voltage by regulating the percentage of time that  
2    voltage is supplied to the electromagnets. This is accomplished by closing a switch (preferably  
3    an electronic switch--such as a transistor, a triac, or a semiconductor-controlled rectifier), *i.e.*,  
4    substantially reducing the resistance between the terminals of the switch, in a circuit between a  
5    source of electrical energy, preferably a battery or other generator of direct current, and the  
6    electromagnets for such desired percentage of time.

7        To assure that force is produced only in the desired direction, the first method for closing  
8    the switch operates only between the time that the first pole of a permanent magnet approaches  
9    the sensor and the time that the second pole of the permanent magnet approaches the sensor; the  
10   third and fourth methods, only when a pole of polarity to which the sensor is sensitive is near  
11   such sensor. Outside of such periods, the switch is left open because no signal is sent to close  
12   such switch.

13       In the first method, input of the desired speed can be provided to a computer through any  
14   means that is well known in the art. The sensor is in communication with the computer and  
15   informs the computer when a pole of a permanent magnet has approached the sensor. The  
16   computer then begins producing a signal to close the switch. Preferably, the output signal from  
17   the computer will be in the form of a square wave, *i.e.*, a periodic wave which has a constant  
18   voltage amplitude when the output is being supplied and zero amplitude during the remainder of  
19   the period. The computer communicates with the switch so that the output signal from the  
20   computer is sent to the switch and causes such switch to be closed for the proportion of the  
21   period during which the output from the computer is non-zero, *i.e.* when a voltage is being  
22   supplied by the computer. The computer adjusts the non-zero proportion of the period to achieve  
23   the desired average voltage being transmitted from the source of electrical energy through the  
24   switch to the electromagnets and, consequently, the desired average speed of the drive wheel.  
25   When the sensor detects that the opposite pole of the permanent magnet has approached the  
26   sensor, the sensor so informs the computer; and the computer terminates the production of an  
27   output signal, causing the switch to be open.

28       In a second method, the computer is replaced with a timing circuit which establishes one  
29   specific proportion of the period during which such timing circuit produces an output voltage of

1 constant amplitude and which produces no output voltage for the remainder of the period. This  
2 proportion can only be changed by adjusting the value of an electric component, such as a  
3 potentiometer, within the timing circuit.

4 When the second method is employed, the sensor, which is preferably a Hall-effect  
5 switch, will produce a current or voltage that is utilized, in any manner that is well known in the  
6 art--such as by completing an electrical circuit from a source of electrical energy, to cause the  
7 timing circuit to begin and to continue operating only while a pole of a given polarity is near the  
8 sensor. Therefore, when a pole of a permanent magnet to which the sensor is sensitive is near the  
9 sensor, the sensor will initiate and maintain the operation of the timing circuit, which in turn will  
10 periodically close a switch, preferably an electronic switch, to energize the electromagnets. Such  
11 switch will remain closed only so long as it receives a voltage output from the timing circuit.  
12 When the opposite pole of the permanent magnet (or no pole) is near the sensor, the sensor will  
13 produce no current; the timing circuit will not be activated; and the switch will, consequently, not  
14 remain closed.

15 Alternatively, with the second method, two sensors could be located near each other.  
16 One sensor could be sensitive to one magnetic pole; the other sensor, to the other magnetic pole.  
17 (This can be accomplished by, for example, reversing the Hall-effect switch.) Then the average  
18 power and, consequently, the speed of the drive wheel would be increased.

19 Additionally, one sensor may be utilized to activate all the electromagnets; or there can  
20 be separate sensors for one or more electromagnets.

21 In a third method, the sensor acts just as in the second method. The sensor, however,  
22 communicates directly with the switch so that the voltage from the sensor is transmitted directly  
23 to the switch and acts just as does the output voltage from the timing circuit. Therefore, with the  
24 third method, no mechanism is included to alter the average voltage that is produced by the  
25 source of electrical power. The voltage produced by the source of electrical power is sent  
26 continuously to the electromagnets throughout the time that a pole of a permanent magnet to  
27 which the sensor is sensitive is near the sensor.

1        When the third method is used, the options with respect to sensors that were discussed for  
2 the second method are again available; and it is preferred to have a separate sensor for each  
3 electromagnet.

4        With all three methods the electrical signal from the sensor is either on or off (not a  
5 continuum of possible values). Therefore, with the first method, the computer can be  
6 programmed to invert the signal it sends to the switch. (Alternatively, an inverter could be  
7 placed--preferably through electronic switching operated by a user--between the sensor and the  
8 computer.) This will cause the switch controlling current to the electromagnets to be activated at  
9 the times other than those when magnetic attraction or repulsion between the permanent magnet  
10 and an electromagnet will produce a force in the original direction that it was desired to rotate the  
11 drive wheel. This will, consequently, at times produce no force and at other times produce a  
12 force that tends to cause the drive wheel to rotate in the reverse direction. If the drive wheel were  
13 already rotating in a forward direction, this would initially have a braking effect. If continued, it  
14 would ultimately result in the drive wheel rotating in the reverse direction. Of course, it would  
15 be more efficient to employ a sensor that is so located (1) that when a specific type of pole  
16 approaches or is near the sensor, magnetic attraction or repulsion between the permanent magnet  
17 and an electromagnet will produce a force to rotate the drive wheel in the reverse direction and  
18 (2) that when the opposite pole of the electromagnet approaches or is near the sensor, magnetic  
19 attraction or repulsion between the permanent magnet and an electromagnet would not produce a  
20 force to rotate the drive wheel in the reverse direction. And this more efficient technique is  
21 within the scope of the present invention.

22       Similarly, to obtain a force that tends to rotate the drive wheel in a reverse direction with  
23 the second method, an inverter is placed (preferably through electronic switching operated by a  
24 user) between the sensor and the timing circuit. And to accomplish this feat with the third  
25 method, an inverter is placed (preferably through electronic switching operated by a user)  
26 between the sensor and the switch.

27       Alternatively with any of the three methods, one or more additional switches or an  
28 H-bridge may be employed to enable current to flow through the electromagnets in a reverse  
29 direction. This would, of course, tend to cause the drive wheel to rotate in the reverse direction.

1     If the drive wheel were already rotating in a forward direction, this would initially have a braking  
2     effect. If continued, it would ultimately result in the drive wheel rotating in the reverse direction.

3                 In the case of the first method, the computer can send signals directing the additional  
4     switch or switches to be set so that the current would flow through the electromagnets in a  
5     forward direction or signals directing the switches to be set so that the current would flow  
6     through the electromagnets in a reverse direction. For the second and third methods, some  
7     outside force (electronic or manual) would have to activate the additional switch or switches.

8                 The computer also has the ability to protect the motor by delaying activation of the  
9     electromagnets until the wheel has attained a desired operational speed through the application of  
10    an outside force, *i.e.*, a force that does not result from the present invention. And the computer  
11    can be programmed to utilize the signal from the sensor to determine the speed of rotation of the  
12    drive wheel.

13                 Furthermore, when it is desired to have more than one drive wheel operating with one  
14    another, a single computer can perform the desired computer functions for all the drive wheels.

15                 Although the source of electrical power for the motor is preferably direct current, the  
16     motor will function with alternating current provided that the a. c. voltage is biased so that it  
17     never has a negative value. Furthermore, any method that is well known in the art can be used to  
18     control the average voltage that is supplied to the electromagnets, although the first two methods  
19     described above are preferred, with the first method being more preferred.

20                 The ends of the core of each electromagnet are preferably bent toward the permanent  
21    magnets in order to increase the attractive and repulsive forces.

22                 Moreover, it has been experimentally determined that the cores of the electromagnets  
23     perform more effectively when such cores are composed, ignoring the bent portion at the ends, of  
24     identical sections that are laminated with the plane of lamination being substantially parallel to  
25     the plane in which the electromagnet lies. Also, it has been experimentally determined that the  
26     electromagnets perform more effectively when they are wound with multi-strand wire.

27                 Preferably, the structure that supports the axle for the drive wheel contains a cavity that  
28     communicates with the electromagnets and can contain either a heat-transfer medium or a  
29     heat-absorbing medium to reduce heat near the electromagnets. When a heat-transfer medium is

1 to be employed, the cavity also communicates with at least one radiating surface, such radiating  
2 surface preferably being either composed of carbon-filled nylon plastic or a metal fin.

3        Optionally, the electromagnets are encapsulated within a module having at least one  
4 radiating surface, such radiating surface preferably being either metal fins or fins composed of a  
5 carbon-filled nylon plastic. The module is removably inserted into the structure that supports the  
6 axle for the drive wheel. Within a cavity of the module is placed a heat-transfer medium (a fluid  
7 or gel) which communicates with both the electromagnets and the radiating surface, thereby  
8 conducting heat from the electromagnets to the radiating surface, from which such heat is  
9 transferred to the surrounding environment.

10      Moreover, in a still further alternative, the electromagnets can either simply be air cooled  
11 or may have liquid circulated between such electromagnets and a radiating heat sink through  
12 tubes or passages. When the tubes are utilized, a unique magnetic pump is employed that is  
13 operated by a magnetic connection between the rotating permanent magnets and a permanent  
14 magnet located in the impeller of the pump. And air cooling may be aided by the attachment of a  
15 fan to the structure that supports the axle for the drive wheel.

16      The simultaneous alignment of more than one electromagnet with more than one  
17 permanent magnet, which is termed "cogging," increases drag. Any technique which will  
18 prevent such cogging, such as having the spacing between electromagnets different from that  
19 between permanent magnets or having the distance between poles of electromagnets different  
20 from that between poles of adjacent permanent magnets, is, therefore preferred.

21      Also, to prevent energy losses caused by coupling between electromagnets, pairs of  
22 electromagnets are preferably activated alternately by the computer in the first method; by  
23 placing a flip-flop between the output of the timing circuit and the electromagnets in the second  
24 method; and, if a single sensor, is utilized for all electromagnets, placing a flip-flop between the  
25 sensor and the electromagnets in the third method.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

2 Figure 1 depicts the drive wheel and rotor of the Electric Motor with Rotor Being a Drive  
3 Wheel.

Figure 2 shows an air-cooled version of the Electric Motor with Rotor Being a Drive Wheel where a computer is employed to control the speed of the drive wheels.

6 Figure 3 illustrates a liquid-cooled version of the Electric Motor with Rotor Being a  
7 Drive Wheel where a computer is employed to control the speed of the drive wheels.

8 Figure 4 portrays the core of a curved electromagnetic, demonstrating the bent ends of the  
9 electromagnet.

Figure 5 is a view of the same embodiment as that of Figure 3 except that the electromagnets are straight, rather than curved.

Figure 6 differs from the embodiment of Figure 5 only in that three electromagnets, rather than two, have been utilized.

Figure 7 shows a module within which the electromagnets are preferably located.

Figure 8 is a view from above the embodiment of Figure 5.

Figure 9 shows an air-cooled version of the Electric Motor with Rotor Being a Drive Wheel using a timing circuit to control the speed of the drive wheel.

Figure 10 illustrates a liquid-cooled version of the Electric Motor with Rotor Being a Drive Wheel using a timing circuit to control the speed of the drive wheel.

20 Figure 11 is a view of the same embodiment as that of Figure 10 except that the  
21 electromagnets are straight, rather than curved.

22           Figure 12 differs from the embodiment of Figure 11 only in that three electromagnets,  
23           rather than two, have been utilized.

Figure 13 shows an air-cooled version of the Electric Motor with Rotor Being a Drive Wheel when only a switch or switches are utilized to connect the source of electrical energy to the electromagnets.

Figure 14 illustrates a liquid-cooled version of the Electric Motor with Rotor Being a Drive Wheel when only a switch or switches are utilized to connect the source of electrical energy to the electromagnets.

1       Figure 15 is a view of the same embodiment as that of Figure 14 except that the  
2 electromagnets are straight, rather than curved.

3       Figure 16 differs from the embodiment of Figure 15 only in that three electromagnets,  
4 rather than two, have been utilized.

5       Figure 17 shows the embodiment incorporating the cavity in the structure to which the  
6 axle of the drive wheel is attached.

7       Figure 18 displays a side view of a permanent magnet.

8       Figure 19 illustrates the drive wheel where the sides of adjacent permanent magnets touch  
9 each other.

10      Figure 20 shows the drive wheel where only one side of each permanent magnet touches  
11 a side of another permanent magnet.

12      Figure 21 portrays an embodiment of the drive wheel in which no side of any permanent  
13 magnet touches the side of any other permanent magnet.

1                    **DESCRIPTION OF THE PREFERRED EMBODIMENT**

2        In the present invention, the drive wheel **1** (a wheel which powers the device to which  
3 such wheel is attached) actually constitutes the rotating portion of an electric motor, *i.e.*, the  
4 rotor.

5        As illustrated in Figure 1, on at least one lateral side of the drive wheel **1**, the wheel **1**  
6 contains one or more (preferably, six) permanent magnets **2**, which are preferably arranged in a  
7 circle, with opposite magnetic poles adjacent to one another. The permanent magnets **2** are  
8 preferably releasably attached to the drive wheel **1**.

9        As viewed from the side, each permanent magnet **2** preferably has a shape which is  
10 defined by the area that is the difference between the sector of one circle and the sector of a  
11 second concentric circle having a smaller radius than the first circle.

12      The poles, however, are preferably at the ends **201**, as illustrated in Figure 18, of each  
13 permanent magnet **2** so that viewing the drive wheel **1** from the side allows one to see only the  
14 pole of a given permanent magnet **2**. Thus, for poles to alternate as described above, a given pole  
15 of one permanent magnet **2** faces the viewer and the opposite pole of the next permanent magnet  
16 **2** faces the viewer. The sides **202** of adjacent permanent magnets **2** may, as shown in Figure 19,  
17 touch each other. Alternatively, as depicted in Figure 20, only one side **202** of each permanent  
18 magnet **2** may touch a side **202** of another permanent magnet **2**. And in a still further  
19 embodiment, which is pictured in Figure 21, no side **202** of any permanent magnet **2** touches the  
20 side **202** of any other permanent magnet **2**.

21      The permanent magnets **2** (or, in the case of the alternative where only one side **202** of  
22 each permanent magnet **2** may touch a side **202** of another permanent magnet **2**, pairs of  
23 permanent magnets **2**) are preferably, but not necessarily, arranged symmetrically.

24      A sensor **3** (preferably located in the structure **4** to which the axle of the drive wheel **1** is  
25 attached)--shown in Figure 2, Figure 3, Figure 5, and Figure 6 (for the first method for  
26 controlling the direction and speed of the drive wheel **1**); in Figure 9, Figure 10, Figure 11, and  
27 Figure 12 (for the second method for controlling the direction and speed of the drive wheel **1**);  
28 and in Figure 13, Figure 14, Figure 15, and Figure 16 (for the third method for controlling the

1 direction and speed of the drive wheel 1)--determines, as described above, the location of the  
2 permanent magnets 2.

3 One or, preferably, more electromagnets 6 are attached to the structure 4 that supports the  
4 axle for the drive wheel 1, creating the stator 7. Such electromagnets 6 are arranged generally in  
5 a plane that is substantially parallel to the plane or planes containing the permanent magnets 2  
6 and are sufficiently close to the permanent magnets 2 that the magnetic fields of the  
7 electromagnets 6 and the permanent magnets 2 will interact with one another. If permanent  
8 magnets 2 are placed upon both of the lateral sides of the drive wheel 1, electromagnets 6 may be  
9 placed upon both sides of the structure 4 that supports the axle for the drive wheel 1.

10 The speed of rotation for the drive wheel 1 is, as discussed above, determined by the  
11 average voltage which is provided to the electromagnets 6. This, as well as assuring that the  
12 drive wheel 1 rotates in the desired direction, is preferably accomplished through one of the three  
13 methods described above. The first method employs the computer 5 (generally in the form of an  
14 integrated circuit chip) and a switch 31, preferably an electronic switch 31. The second method  
15 utilizes a timing circuit 50 of any nature that is well known in the art and the switch 31. And the  
16 third method merely uses the switch 31.

17 To cause the drive wheel 1 to tend to rotate in a reverse direction when the first method is  
18 utilized, the computer 5 can be programmed to invert the output signal that it sends to the switch  
19 31. (Alternatively, an inverter 33 can be placed--preferably through electronic switching directed  
20 by the computer 5--between the sensor 3 and the computer 5.) To accomplish this same goal  
21 when the timing circuit 50 is employed, the inverter 33 is placed (preferably by electronic  
22 switching operated by a user) between the sensor 3 and the timing circuit 50. And to achieve a  
23 similar result with the third method, the inverter 33 is placed (preferably by electronic switching  
24 operated by a user) between the sensor 3 and the switch 31.

25 Alternatively with all three methods, one or more additional switches or an H-bridge 33  
26 may be employed to enable current to flow through the electromagnets 6 in a reverse direction.  
27 This would, of course, tend to cause the drive wheel 1 to rotate in the reverse direction. If the  
28 drive wheel 1 were already rotating in a forward direction, this would initially have a braking

1 effect. If continued, it would ultimately result in the drive wheel 1 rotating in the reverse  
2 direction.

3       The electromagnets 6, as viewed from the side, preferably are rectangular in shape, as  
4 illustrated in Figure 5, Figure 6, Figure 11, Figure 12, Figure 15, and Figure 16, although the  
5 electromagnets 6 may have other shapes, including a shape similar to that of the permanent  
6 magnets 2, as illustrated in Figure 2, Figure 3, Figure 9, Figure 10, Figure 13, and Figure 14.  
7       Also there are preferably two electromagnets 6, and the two electromagnets are preferably  
8 arranged in an inverted "V," as depicted in Figure 5, Figure 11, and Figure 15. Optionally,  
9 however, three electromagnets 6 can be arranged with one electromagnet 6 placed horizontally  
10 and an electromagnet 6 placed vertically below each end of the horizontal electromagnet 6 as  
11 shown in Figure 6, Figure 12, and Figure 16.

12       As illustrated in Figure 4, the ends 8 of the core of each electromagnet 6 are preferably  
13 bent toward the permanent magnets 2 in order to increase the attractive and repulsive forces.

14       Moreover, it has been experimentally determined that the cores of the electromagnets 6  
15 perform more effectively when such cores are composed, ignoring the bent portion at the ends 8,  
16 of identical sections 9 that are laminated with the plane of lamination being substantially parallel  
17 to the plane in which the electromagnet 6 lies. Also, it has been experimentally determined that  
18 the electromagnets 6 perform more effectively when they are wound with multi-strand cable.

19       Preferably, as discussed above and as depicted in Figure 17, the structure 4 that supports  
20 the axle for the drive wheel 1 contains a cavity 34 that communicates with the electromagnets 6  
21 and can contain either a heat-transfer medium 35 or a heat-absorbing 35 medium to reduce heat  
22 near the electromagnets 6. When a heat-transfer medium 35 is to be employed, the cavity 34 also  
23 communicates with at least one radiating surface 36, such radiating surface 36 preferably either  
24 being composed of carbon-filled nylon plastic or comprising a fin made of metal. Examples of  
25 heat-transfer media 35 are antifreeze and heat sink compound. Examples of heat-transfer media  
26 35 or heat-absorbing media 35 are wax; plastic-encapsulated wax spheres such as those sold  
27 under the trade name THERMASORB® by Frisby Technologies, Inc. of Winston-Salem, North  
28 Carolina; and such plastic-encapsulated wax spheres mixed into mineral oil. Of these examples,  
29 it has been experimentally determined that heat sink compound performs most satisfactorily.

1        Optionally and again as considered above, as shown in Figure 7, the electromagnets 6 are  
2    encapsulated within a module 10 having a radiating surface, preferably metal (or carbon-filled  
3    nylon plastic) fins, 11. The module 10 is removably inserted into the structure 4 that supports the  
4    axle for the drive wheel 1. Within a cavity 37 of the module 10 is placed a heat-transfer medium  
5    12 (a gel or fluid 12) which communicates with both the electromagnets 6 and the radiating  
6    surface 11, thereby conducting heat from the electromagnets 6 to the radiating surface 11, from  
7    which such heat is transferred to the surrounding environment.

8        Moreover, in a still further alternative, the electromagnets 6 can either simply be air  
9    cooled or may have liquid circulated between such electromagnets 6 and a radiating heat sink 13,  
10   as illustrated in Figure 8. Such liquid may, for example, be antifreeze or water.

11       If the electromagnets 6 are liquid cooled, the liquid cooling fluid 14 is--as shown in  
12   Figure 3, Figure 5, Figure 8, Figure 10, Figure 11, Figure 14, and Figure 15--preferably pumped  
13   by means of a magnetic pump 15 which is turned by the interaction between the permanent  
14   magnets 2 of the drive wheel 1 and a permanent magnet 16 located in the impeller 17 of the  
15   pump 15.

16       The impeller magnet 16 is preferably cylindrical and is preferably installed  
17   perpendicularly to the axis of rotation 18 for the impeller 17 and so as to have the longitudinal  
18   axis of the impeller magnet 16 bisect the angle between any two adjacent vanes 19 of the  
19   impeller 17. (Preferably, the impeller 17 has four vanes 19.)

20       The impeller 17 is located within the magnetic field created by the closest permanent  
21   magnet 2 to the impeller 17. Therefore, as the permanent magnets 2 rotate with the drive wheel  
22   1, magnetic attraction and repulsion cause the impeller magnet 16 to rotate, thereby rotating the  
23   impeller 17. Cooling fluid 14 flows into the impeller 17 from an aperture 20 on a first side 21 of  
24   the impeller 17 and is pushed by the rotating vanes 19 to a second side 22 of the impeller 17  
25   where such cooling fluid 14 exits from the impeller 17 through an aperture 23. The cooling fluid  
26   14 is thereby forced through a tube or passage 24 past the electromagnets 6 and along the  
27   radiating heat sink 13 before being returned to the magnetic pump 15. A first end 25 of the tube  
28   or passage 24 is connected to aperture 23 of the pump 15, and a second end 26 of the tube or  
29   passage 24 is attached to aperture 20 of the magnetic pump 15.

1        When air cooling is employed, such cooling may be aided by the attachment, through any  
2 method that is well known in the art, of a fan **38** to the structure **4** that supports the axle for the  
3 drive wheel **1** in order to force more air past the electromagnets **6**.

4        Preferably, to prevent energy losses caused by coupling between electromagnets **6**, pairs  
5 of electromagnets **6** are activated alternately by the computer in the first method; by placing a  
6 flip-flop **401** between the output of the timing circuit **50** and the electromagnets **6** in the second  
7 method; and, if a single sensor **3**, is utilized for all electromagnets **6**, placing a flip-flop **401**  
8 between the sensor **3** and the electromagnets **6** in the third method.

9

1

**CLAIMS**

2       We claim:

1       1. An electric motor, which comprises:

2              a drive wheel;

3              a structure to which said drive wheel is rotatably attached;

4              one or more permanent magnets attached to said drive wheel with opposite  
5              magnetic poles adjacent to one another;

6              one or more electromagnets attached to said structure and arranged generally in a  
7              plane that is substantially parallel to the plane or planes containing said permanent  
8              magnets, said electromagnets being sufficiently close to said permanent magnets that the  
9              magnetic fields of said electromagnets and said permanent magnets will interact with one  
10             another;

11             a sensor that determines the location of said permanent magnets;

12             a switch for activating said electromagnets by connecting said electromagnets to a  
13             source of electrical power; and

14             a computer, said computer being capable of receiving input of the desired speed of  
15             rotation for said drive wheel, said computer being in communication with said sensor so  
16             that said computer is informed by said sensor about the location of said permanent  
17             magnets, said computer also being in communication with said switch in order to close  
18             said switch, said computer being capable of being programmed to produce a signal to  
19             close said switch periodically from the time a pole of one of said permanent magnets has  
20             approached said sensor until the opposite pole of said permanent magnet approaches said  
21             sensor, and said computer producing such a periodic signal to close said switch that the  
22             total period said switch is closed will create an average voltage that produces the desired  
23             speed of rotation for said drive wheel.

1       2. The electric motor as recited in claim 1, wherein:

2              said computer has been further programmed to have the capability to invert the  
3              signal it sends to said switch.

4       3. The electric motor as recited in claim 2, further comprising:

5           a magnetic pump containing a magnet, which magnetic pump is operated by  
6           interaction between said permanent magnets and the magnet in said magnetic pump;

7           a radiating heat sink; and

8           a passage for transporting a cooling fluid from said magnetic pump, past said  
9           electromagnets, to said radiating heat sink, and back to said magnetic pump.

1         4. The electric motor as recited in claim 2, further comprising:

2           a module encapsulating one or more of said electromagnets, having a radiating  
3           surface, and containing a cavity that communicates with both said electromagnets and the  
4           radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5           module being removably insertable into said structure.

1         5. The electric motor as recited in claim 2, wherein:

2           said structure contains a cavity that communicates with said electromagnets and  
3           can contain either a heat-transfer medium or a heat-absorbing medium.

1         6. The electric motor as recited in claim 5, further comprising:

2           at least one radiating surface, said radiating surface communicating with said  
3           cavity.

1         7. The electric motor as recited in claim 1, further comprising:

2           a module encapsulating one or more of said electromagnets, having a radiating  
3           surface, and containing a cavity that communicates with both said electromagnets and the  
4           radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5           module being removably insertable into said structure.

1         8. The electric motor as recited in claim 1, wherein:

2           said structure contains a cavity that communicates with said electromagnets and  
3           can contain either a heat-transfer medium or a heat-absorbing medium.

1         9. The electric motor as recited in claim 8, further comprising:

2           at least one radiating surface, said radiating surface communicating with said  
3           cavity.

1           10. The electric motor as recited in claim 1, further comprising:  
2                 a magnetic pump containing a magnet, which magnetic pump is operated by  
3                 interaction between said permanent magnets and the magnet in said magnetic pump;  
4                 a radiating heat sink; and  
5                 a passage for transporting a cooling fluid from said magnetic pump, past said  
6                 electromagnets, to said radiating heat sink, and back to said magnetic pump.  
7           11. An electric motor, which comprises:  
8                 a drive wheel;  
9                 a structure to which said drive wheel is rotatably attached;  
10                 one or more permanent magnets attached to said drive wheel with opposite  
11                 magnetic poles adjacent to one another;  
12                 one or more electromagnets attached to said structure and arranged generally in a  
13                 plane that is substantially parallel to the plane or planes containing said permanent  
14                 magnets, said electromagnets being sufficiently close to said permanent magnets that the  
15                 magnetic fields of said electromagnets and said permanent magnets will interact with one  
16                 another;  
17                 a sensor that produces a current only so long as a pole, having a given polarity, of  
18                 one of said permanent magnets is near said sensor;  
19                 a switch for activating said electromagnets by connecting said electromagnets to a  
20                 source of electrical power; and  
21                 a timing circuit, said timing circuit being in communication with said sensor, said  
22                 timing circuit also being in communication with said switch in order to close said switch,  
23                 said timing circuit producing a periodic signal to close said switch only while said sensor  
24                 produces a current, and said timing circuit producing a periodic signal to close such  
25                 switch wherein the total period said switch is closed is fixed by the value of an electronic  
26                 component within said timing circuit.

1           12. The electric motor as recited in claim 11, further comprising:

2                   an inverter, said inverter being electronically inserted by a user between said  
3 sensor and said timing circuit, for causing an inversion of any electronic signal that is  
4 sent from said sensor to said timing circuit.

1         13. The electric motor as recited in claim 12, further comprising:

2                   a magnetic pump containing a magnet, which magnetic pump is operated by  
3 interaction between said permanent magnets and the magnet in said magnetic pump;

4                   a radiating heat sink; and

5                   a passage for transporting a cooling fluid from said magnetic pump, past said  
6 electromagnets, to said radiating heat sink, and back to said magnetic pump.

1         14. The electric motor as recited in claim 12, further comprising:

2                   a module encapsulating one or more of said electromagnets, having a radiating  
3 surface, and containing a cavity that communicates with both said electromagnets and the  
4 radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5 module being removably insertable into said structure.

1         15. The electric motor as recited in claim 12, wherein:

2                   said structure contains a cavity that communicates with said electromagnets and  
3 can contain either a heat-transfer medium or a heat-absorbing medium.

1         16. The electric motor as recited in claim 15, further comprising:

2                   at least one radiating surface, said radiating surface communicating with said  
3 cavity.

1         17. The electric motor as recited in claim 11, further comprising:

2                   a module encapsulating one or more of said electromagnets, having a radiating  
3 surface, and containing a cavity that communicates with both said electromagnets and the  
4 radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5 module being removably insertable into said structure.

1         18. The electric motor as recited in claim 11, wherein:

2                   said structure contains a cavity that communicates with said electromagnets and  
3 can contain either a heat-transfer medium or a heat-absorbing medium.

1         19. The electric motor as recited in claim 16, wherein:

2 at least one radiating surface, said radiating surface communicating with said  
3 cavity.

1 20. The electric motor as recited in claim 11, further comprising:

2 a magnetic pump containing a magnet, which magnetic pump is operated by  
3 interaction between said permanent magnets and the magnet in said magnetic pump;

4 a radiating heat sink; and

5 a passage for transporting a cooling fluid from said magnetic pump, past said  
6 electromagnets, to said radiating heat sink, and back to said magnetic pump.

1 21. An electric motor, which comprises:

2 a drive wheel;

3 a structure to which said drive wheel is rotatably attached;

4 one or more permanent magnets attached to said drive wheel with opposite  
5 magnetic poles adjacent to one another;

6 one or more electromagnets attached to said structure and arranged generally in a  
7 plane that is substantially parallel to the plane or planes containing said permanent  
8 magnets, said electromagnets being sufficiently close to said permanent magnets that the  
9 magnetic fields of said electromagnets and said permanent magnets will interact with one  
10 another;

11 a sensor that produces a voltage only so long as a pole, having a given polarity, of  
12 one of said permanent magnets is near said sensor; and

13 a switch for activating said electromagnets by connecting said electromagnets to a  
14 source of electrical power, said switch being in communication with said sensor and said  
15 switch being closed when and only when said switch receives voltage from said sensor.

1 22. The electric motor as recited in claim 21, further comprising:

2 an inverter, said inverter being electronically inserted by a user between said  
3 sensor and said switch, for causing an inversion of any electronic signal that is sent from  
4 said sensor to said switch.

1           23. The electric motor as recited in claim 22, further comprising:  
2                 a magnetic pump containing a magnet, which magnetic pump is operated by  
3                 interaction between said permanent magnets and the magnet in said magnetic pump;  
4                 a radiating heat sink; and  
5                 a passage for transporting a cooling fluid from said magnetic pump, past said  
6                 electromagnets, to said radiating heat sink, and back to said magnetic pump.

1           24. The electric motor as recited in claim 22, further comprising:  
2                 a module encapsulating one or more of said electromagnets, having a radiating  
3                 surface, and containing a cavity that communicates with both said electromagnets and the  
4                 radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5                 module being removably insertable into said structure.

1           25. The electric motor as recited in claim 22, wherein:  
2                 said structure contains a cavity that communicates with said electromagnets and  
3                 can contain either a heat-transfer medium or a heat-absorbing medium.

1           26. The electric motor as recited in claim 25, further comprising:  
2                 at least one radiating surface, said radiating surface communicating with said  
3                 cavity.

1           27. The electric motor as recited in claim 21, further comprising:  
2                 a module encapsulating one or more of said electromagnets, having a radiating  
3                 surface, and containing a cavity that communicates with both said electromagnets and the  
4                 radiating surface so that a heat-transfer medium can be placed into such cavity, said  
5                 module being removably insertable into said structure.

1           28. The electric motor as recited in claim 21, wherein:  
2                 said structure contains a cavity that communicates with said electromagnets and  
3                 can contain either a heat-transfer medium or a heat-absorbing medium.

1           29. The electric motor as recited in claim 28, further comprising:  
2                 at least one radiating surface, said radiating surface communicating with said  
3                 cavity.

1           30. The electric motor as recited in claim 21, further comprising:

2           a magnetic pump containing a magnet, which magnetic pump is operated by  
3           interaction between said permanent magnets and the magnet in said magnetic pump;  
4           a radiating heat sink; and  
5           a passage for transporting a cooling fluid from said magnetic pump, past said  
6           electromagnets, to said radiating heat sink, and back to said magnetic pump.

1       31. A process for electrically powering a drive wheel, which comprises:  
2           rotatably attaching a drive wheel to a structure;  
3           attaching to said drive wheel one or more permanent magnets with opposite  
4           magnetic poles adjacent to one another;  
5           attaching to said structure one or more electromagnets arranged generally in a  
6           plane that is substantially parallel to the plane or planes containing said permanent  
7           magnets, said electromagnets being sufficiently close to said permanent magnets that the  
8           magnetic fields of said electromagnets and said permanent magnets will interact with one  
9           another;  
10          determining the location of said permanent magnets with a sensor;  
11          connecting a switch for activating said electromagnets between said  
12          electromagnets and a source of electrical power;  
13          inputting to a computer the desired speed of rotation for said drive wheel;  
14          having said sensor inform said computer about the location of said permanent  
15          magnets;  
16          connecting said computer to said switch;  
17          programming said computer to produce a signal to close said switch periodically  
18          from the time a pole of one of said permanent magnets has approached said sensor until  
19          the opposite pole of said permanent magnet approaches said sensor; and  
20          producing with said computer such a periodic signal to close said switch so that  
21          the total period said switch is closed will create an average voltage that produces the  
22          desired speed of rotation for said drive wheel.  
1       32. A process for electrically powering a drive wheel, which comprises:  
2           rotatably attaching a drive wheel to a structure;

3                   attaching to said drive wheel one or more permanent magnets with opposite  
4                   magnetic poles adjacent to one another;

5                   attaching to said structure one or more electromagnets arranged generally in a  
6                   plane that is substantially parallel to the plane or planes containing said permanent  
7                   magnets, said electromagnets being sufficiently close to said permanent magnets that the  
8                   magnetic fields of said electromagnets and said permanent magnets will interact with one  
9                   another;

10                  producing a current with as sensor that creates such current only so long as a pole,  
11                  having a given polarity, of one of said permanent magnets is near said sensor;

12                  connecting a switch for activating said electromagnets between said  
13                  electromagnets and a source of electrical power;

14                  connecting said sensor to said timing circuit;

15                  connecting said timing circuit to said switch; and

16                  producing with said timing circuit a periodic signal to close said switch only  
17                  while said sensor produces a current, wherein the total period for which said periodic  
18                  signal closes said switch is fixed by the value of an electronic component within said  
19                  timing circuit.

1                  33. A process for electrically powering a drive wheel, which comprises:

2                  rotatably attaching a drive wheel to a structure;

3                  attaching to said drive wheel one or more permanent magnets with opposite  
4                  magnetic poles adjacent to one another;

5                  attaching to said structure one or more electromagnets arranged generally in a  
6                  plane that is substantially parallel to the plane or planes containing said permanent  
7                  magnets, said electromagnets being sufficiently close to said permanent magnets that the  
8                  magnetic fields of said electromagnets and said permanent magnets will interact with one  
9                  another;

10                 producing a voltage with as sensor that creates such voltage only so long as a  
11                 pole, having a given polarity, of one of said permanent magnets is near said sensor;

12 connecting a switch between said electromagnets and a source of electrical power;  
13 and  
14 connecting said sensor to said switch so that said switch closes when and only  
15 when said switch receives voltage from said sensor.

## **ABSTRACT**

An electric motor with rotor being a drive wheel. The drive wheel has one or more permanent magnets attached to said drive wheel with opposite magnetic poles adjacent to one another. One or more electromagnets are attached to the structure to which the drive wheel is rotatably connected. A sensor determines the location of the permanent magnets. This information is utilized to assure that the electromagnets are energized only when the resultant magnetic fields will interact with the magnetic fields of the permanent magnet to produce a force on the drive wheel that will cause rotation in the desired direction. Three principal embodiments are employed. In a first embodiment, a computer periodically activates a switch to send pulsed voltage to the electromagnets; the percentage of the period of each pulse during which the voltage is non-zero determines the speed of the drive wheel. In a second embodiment, the computer is replaced with a timing circuit that controls the switch. And in a third embodiment, the output from the sensor directly controls the switch.

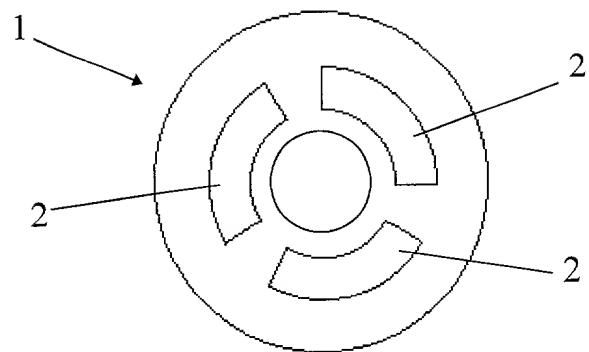


Figure 1

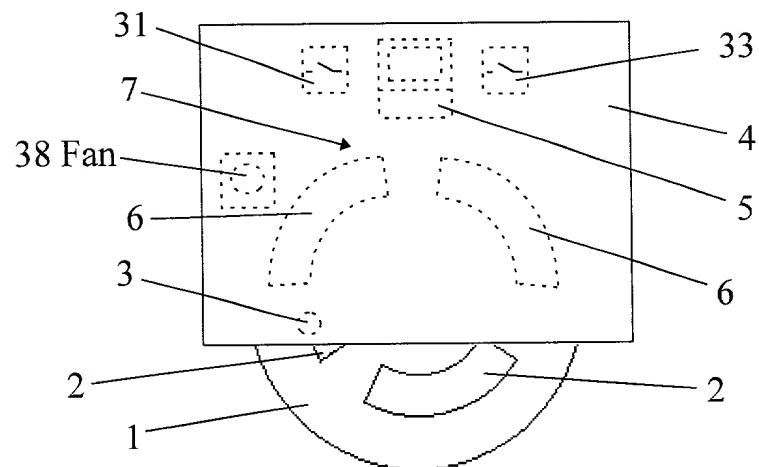


Figure 2

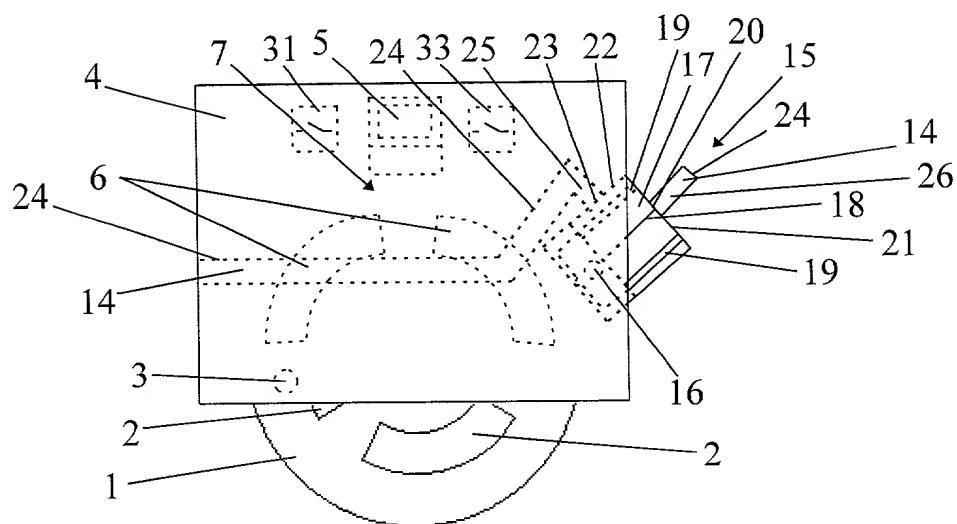


Figure 3

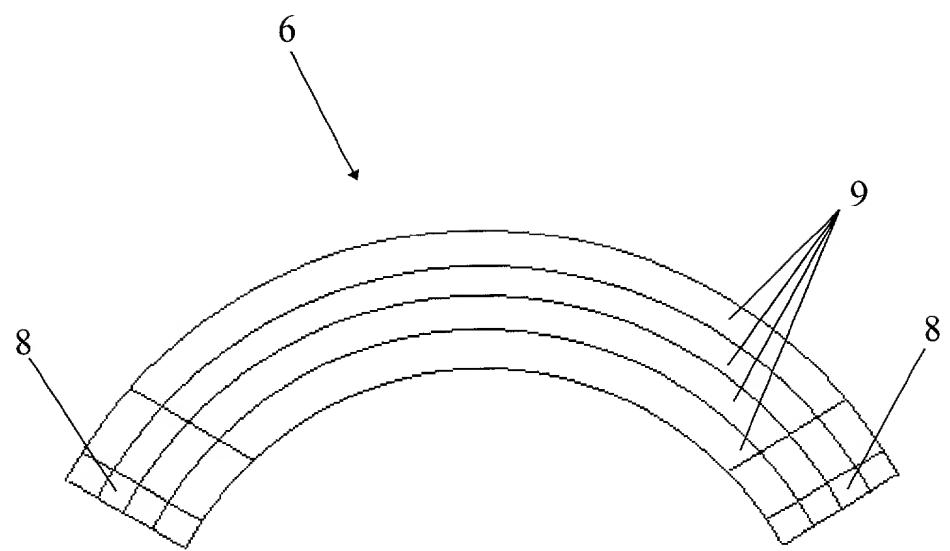


Figure 4

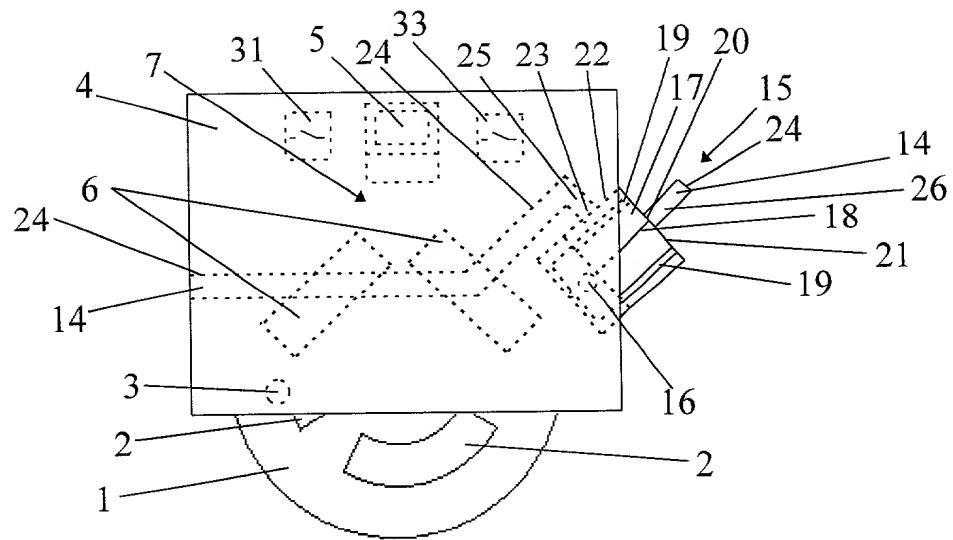


Figure 5

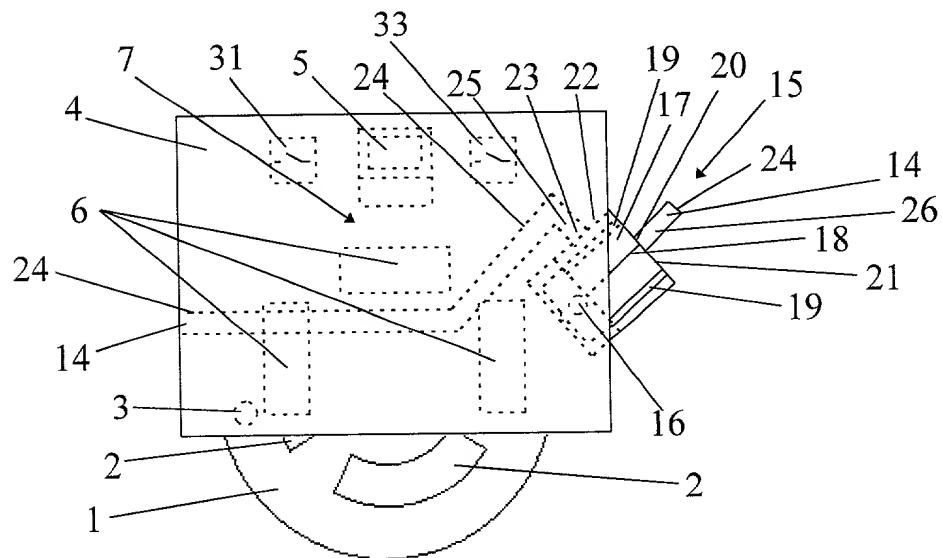


Figure 6

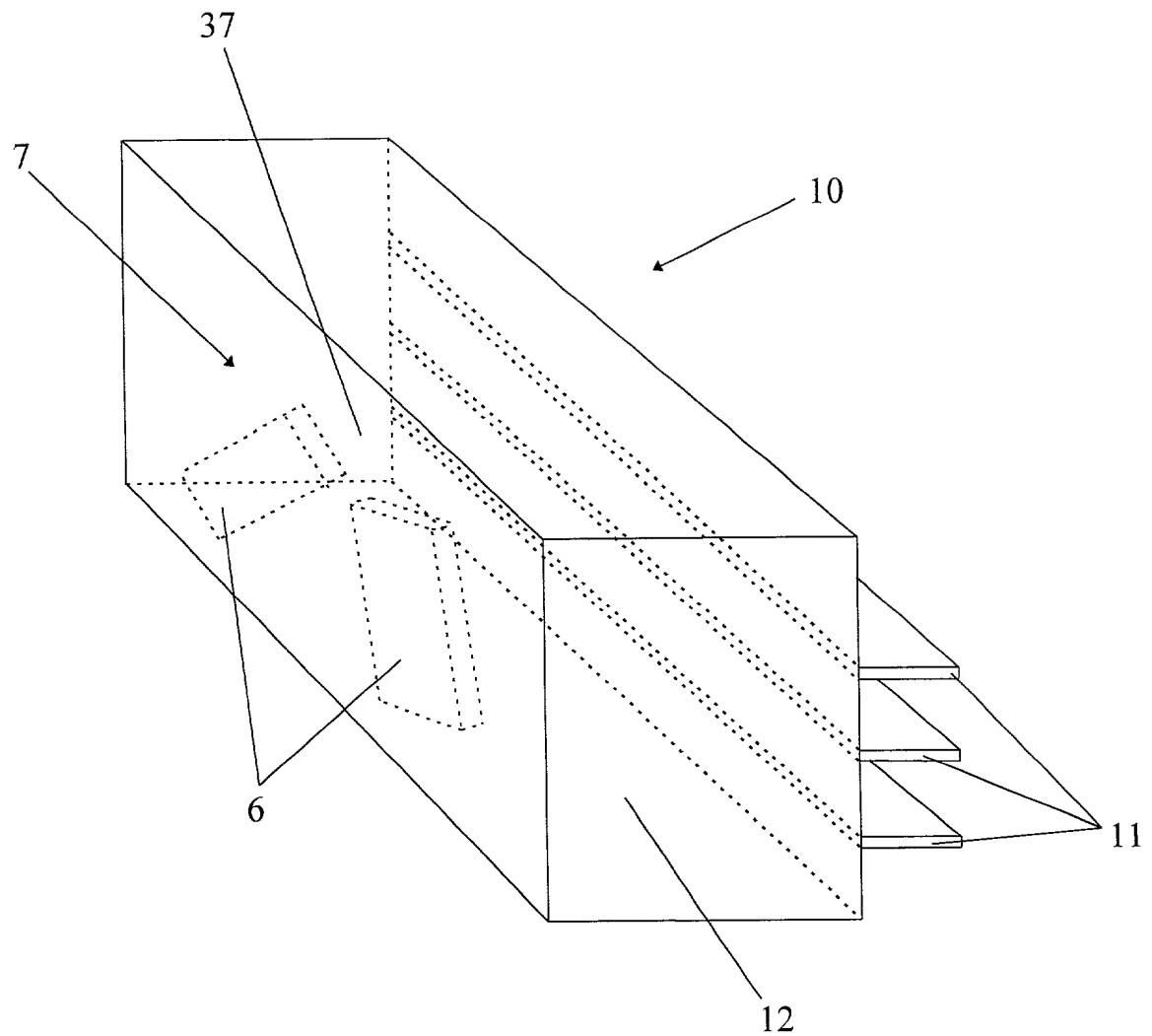


Figure 7

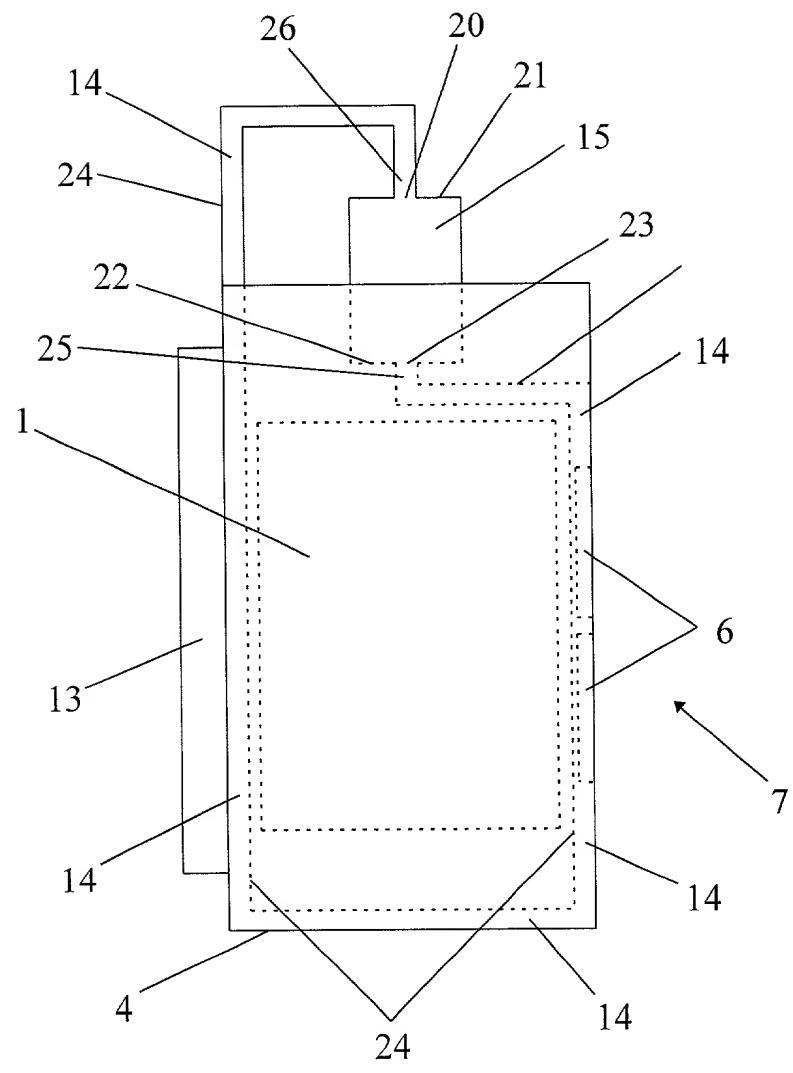


Figure 8

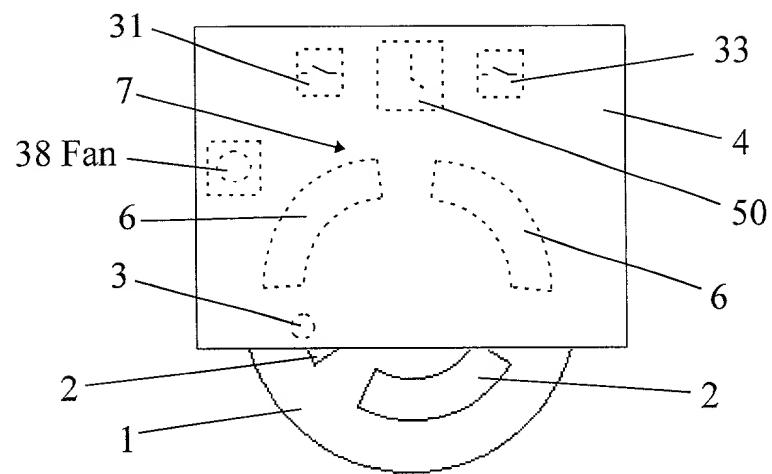


Figure 9

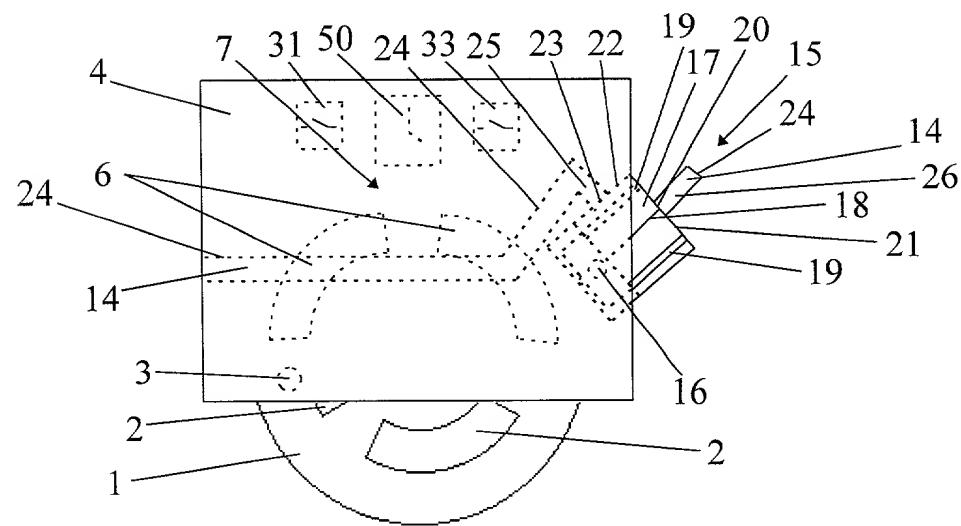


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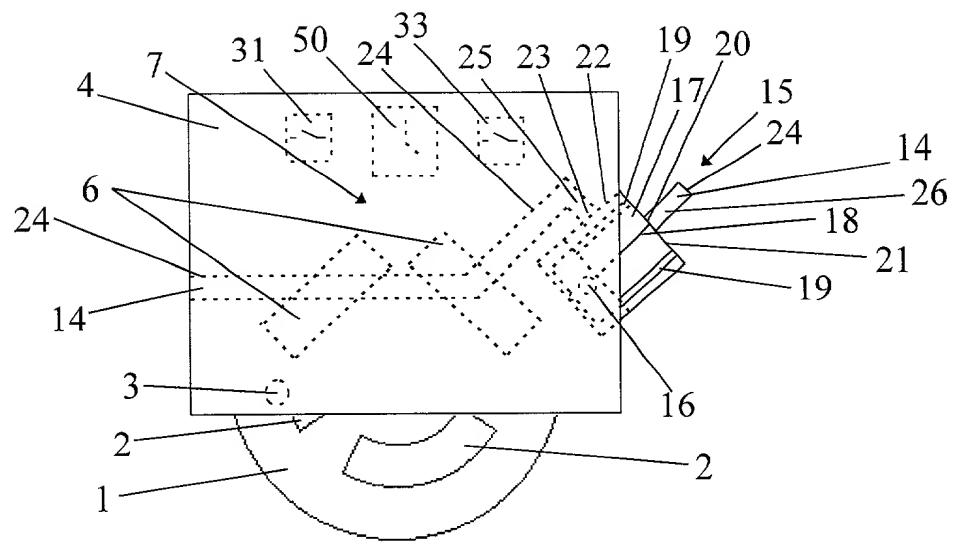


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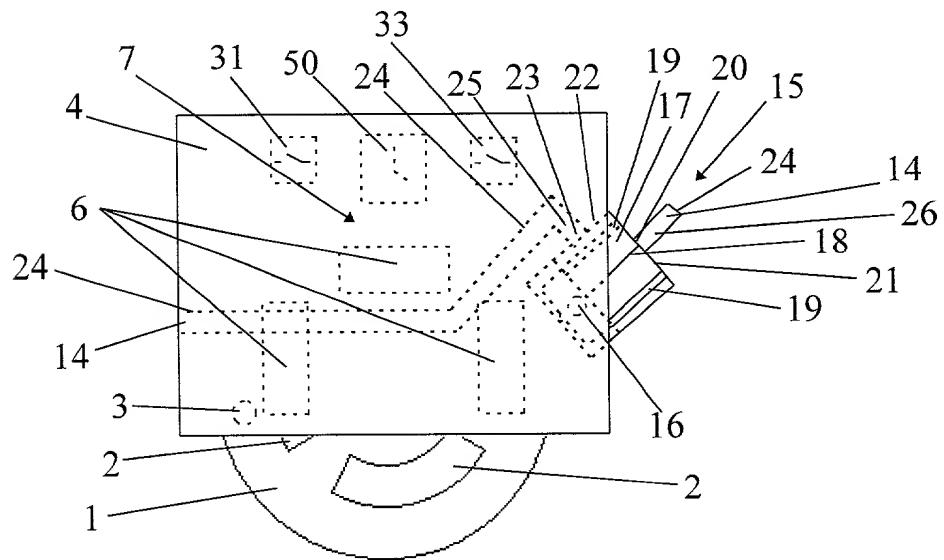


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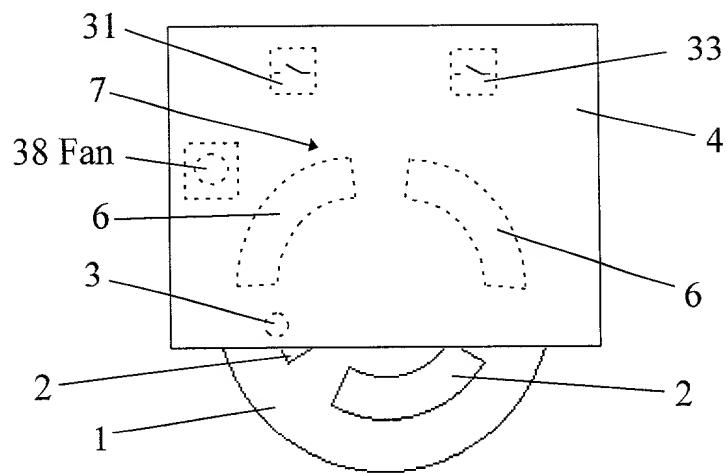


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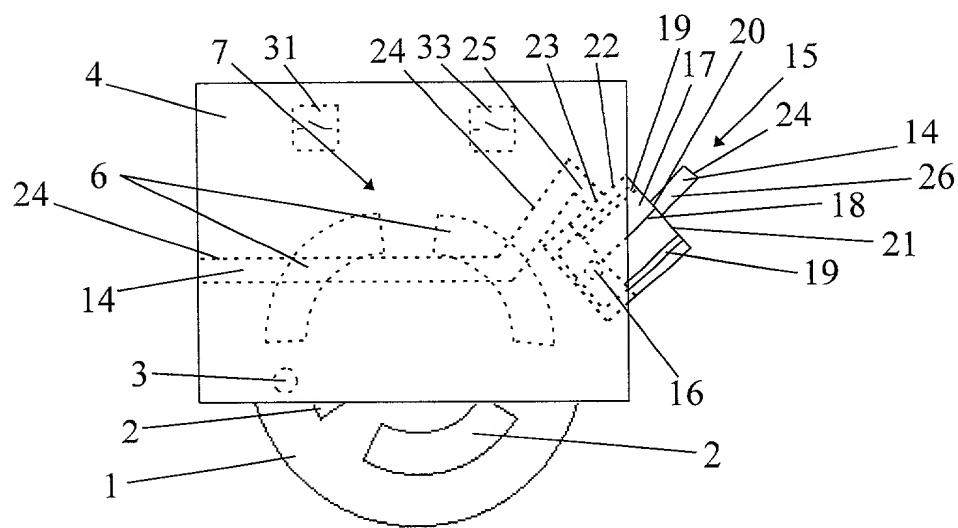


Figure 14

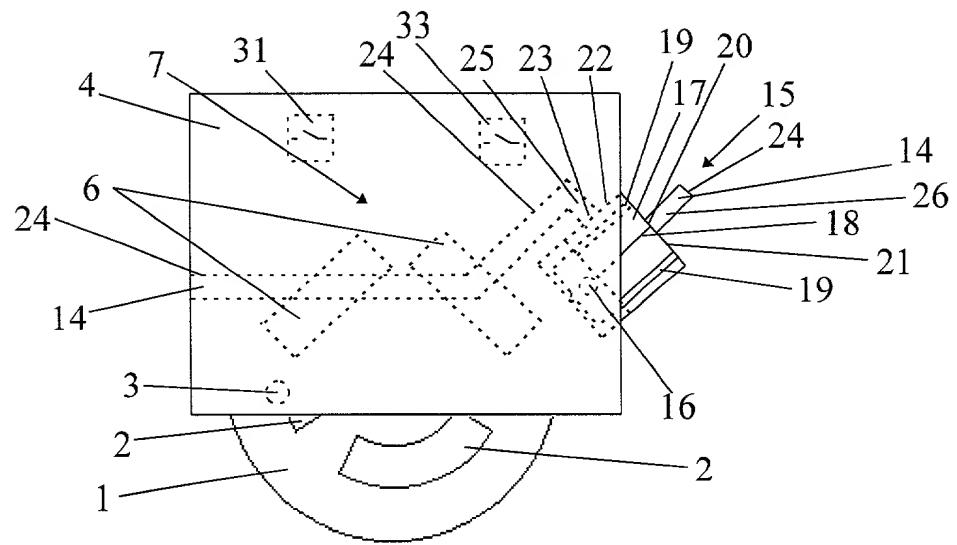


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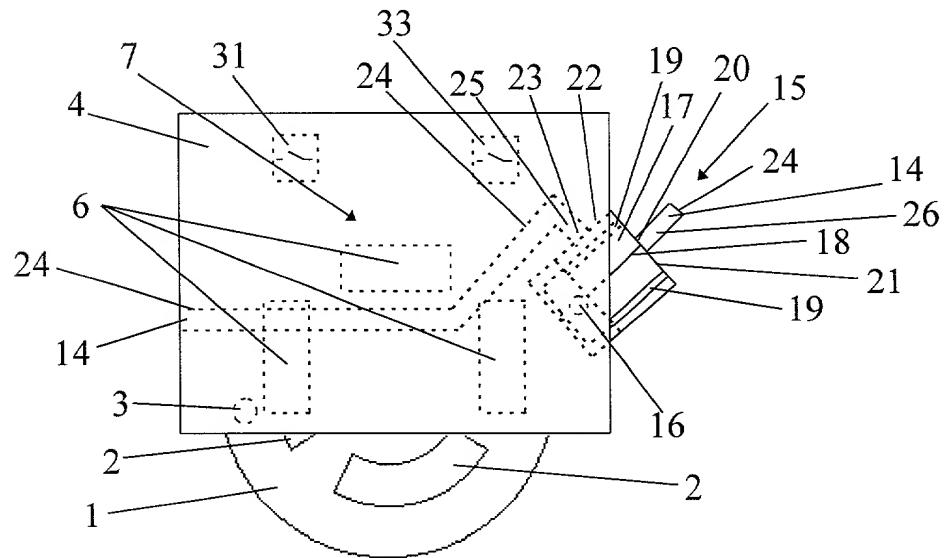


Figure 16

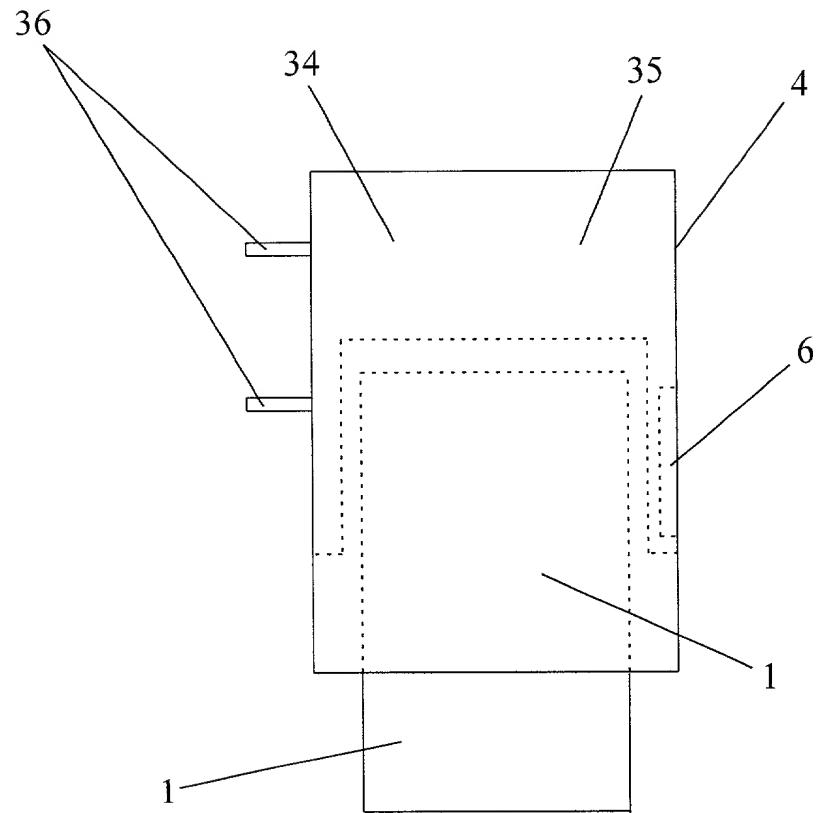


Figure 17

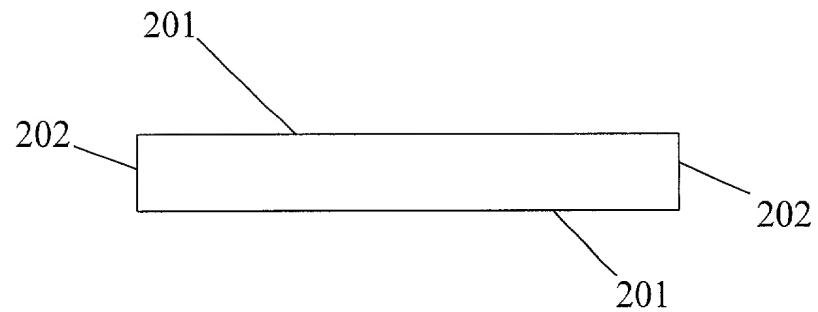


Figure 18

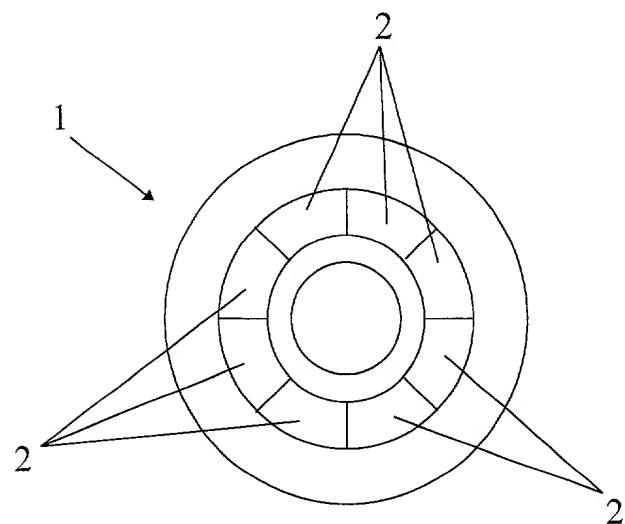


Figure 19

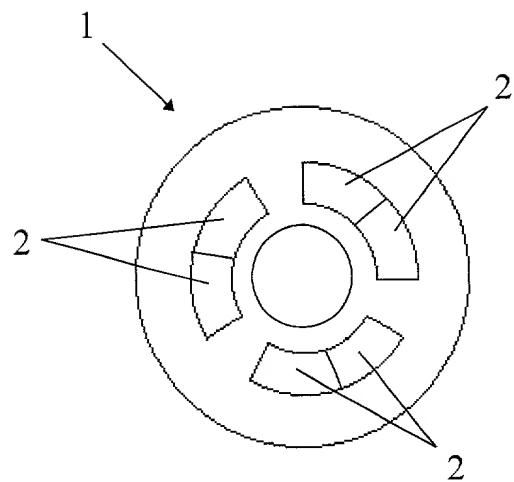


Figure 20

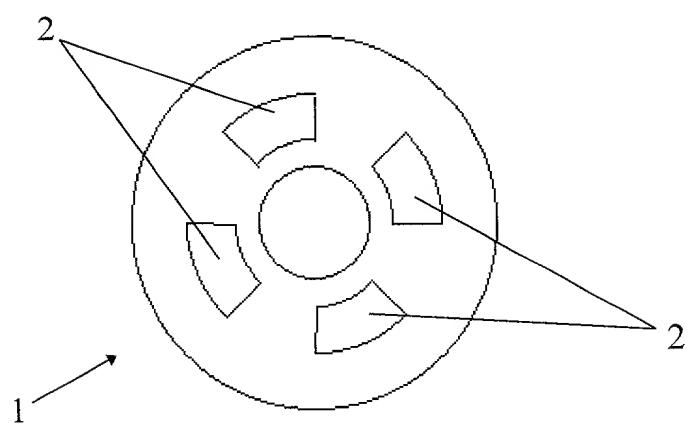


Figure 21

Express Mail Label No. EE235313804US  
Attorney's Docket No. PBRANAEM

PATENT

**COMBINED DECLARATION AND POWER OF ATTORNEY**

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,  
CONTINUATION OR C-I-P)

As a below-named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type: original declaration

**INVENTORSHIP IDENTIFICATION**

My residence, post office address, and citizenship are as stated below next to my name. I believe I am an original, first, and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**TITLE OF INVENTION**

Electric Motor with Rotor Being a Drive Wheel

**SPECIFICATION IDENTIFICATION**

the specification of which is attached hereto.

**ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR**

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 Code of Federal Regulations § 1.56.

**PRIORITY CLAIM (35 U.S.C. § 119)**

I hereby claim foreign priority benefits under Title 35 United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the

United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

No such applications have been filed.

**CLAIM FOR BENEFIT OF EARLIER U.S. APPLICATION UNDER  
35 U.S.C. 120**

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, I acknowledge the duty to disclose information that is material to the examination of this application, namely, information where there is substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, which occurred between the filing date of the prior application(s) and the national filing date of this application.

No such applications have been filed.

**POWER OF ATTORNEY**

I hereby appoint the following attorney to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Thompson E. Fehr  
Registration No. 31,353

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(801) 393-6292

**DECLARATION**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States

Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

### SIGNATURES

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**Inventor's signature** 

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**Inventor's signature** 

**Date:** December 15, 1998      **Country of Citizenship:** United States of America

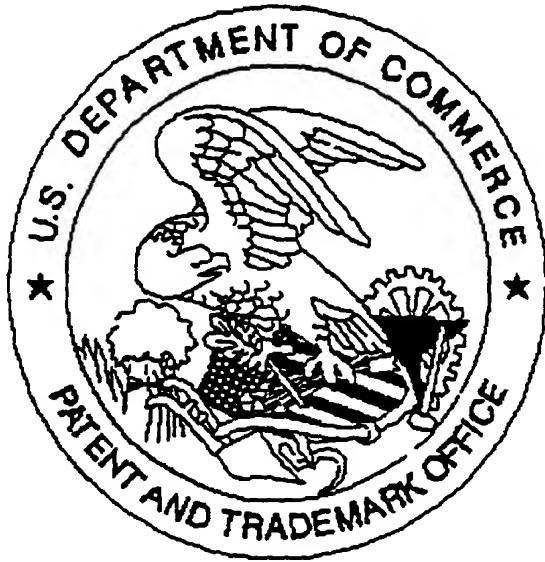
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